

Sub P

The Invention Claimed Is:

1. A storage network having a host device operative to access stored data, a plurality of storage devices operative to store the stored data and a switched fabric connecting the host device and the plurality of storage devices to communicate data access requests and transfer data between the host device and the storage devices, the switched fabric comprising:

 - a host-side link connected to the host device and including a host-side interface to the host device, the host-side interface sending and receiving data to and from the host device;
 - a plurality of storage-side links connected to the plurality of storage devices and each including a storage-side interface to a corresponding one of the storage devices, the storage-side interface sending and receiving data to and from the corresponding storage device; and
 - a switch matrix connected to the host-side link and the storage-side links and operative to establish communication channels between the host-side link and any of the storage-side links for transferring message packets including the data between the host device and any of the storage devices, the switch matrix not establishing communication channels between the storage-side links.
2. A storage network as defined in claim 1 wherein:

 - the switched fabric further comprises a switch connected to the host device and the storage devices; and
 - the host-side link, the plurality of storage-side links and the switch matrix are integrated in the switch in a single integrated circuit.
3. A storage network as defined in claim 2 wherein:

 - the switched fabric further comprises:

 - a second switch, in addition to the switch first aforesaid, connected to the host device and the storage devices;
 - a second host-side link integrated in the second switch and connected to the host device and including a second host-side interface to the host device, wherein the second host-side interface sends and receives data to and

from the host device, the second host-side link being in addition to the host-side link first aforesaid integrated in the first switch and the second host-side interface

- 10 being in addition to the host-side interface first aforesaid included in the first host-side link;

a plurality of second storage-side links integrated in the second switch and connected to the plurality of storage devices and each including a second storage-side interface to the storage devices, wherein the second

- 15 storage-side interfaces send and receive data to and from the storage devices, the second storage-side links being in addition to the storage-side links first aforesaid integrated in the first switch and the second storage-side interfaces being in addition to the storage-side interfaces first aforesaid included in the first storage-side links; and

20 a second switch matrix integrated in the second switch and connected to the second host-side link and the second storage-side links and operative to establish second communication channels between the second host-side link and any of the second storage-side links for transferring the message packets including the data between the host device and any of the storage devices,

- 25 the second switch matrix not establishing communication channels between the second storage-side links, the second switch matrix being in addition to the switch matrix first aforesaid integrated in the first switch and the second communication channels being in addition to the communication channels first aforesaid established by the first switch matrix;

30 and wherein the host device is operative to access the stored data through the switched fabric through either of the first or second switches to the storage devices.

4. A storage network as defined in claim 3 wherein the first and second switches form redundant data transfer paths between the host device and the storage devices

5. A storage network as defined in claim 1 further comprising:

a second host device, in addition to the host device first aforesaid.

connected to the switched fabric;

and wherein:

5 the switched fabric further comprises a second host-side link,
in addition to the host-side link first aforesaid;

the second host-side link connects to the second host device
and includes a second host-side interface, in addition to the host-side interface first
aforesaid, to the second host device;

10 the second host-side interface sends and receives the data to
and from the second host device; and

the switch matrix also connects to the second host-side link
and is further operative to establish the communication channels between the
second host-side link and any of the storage-side links for transferring the message

15 packets including the data between the second host device and any of the storage
devices.

6. A storage network as defined in claim 5 wherein:

the switch matrix is further operative to establish a first one of the
communication channels between the first host-side link and a first one of the
storage-side links and a second one of the communication channels between the

5 second host-side link and a second one of the storage-side links for simultaneous
transfer of data between the first and second host devices and the storage devices
connected to the first and second ones of the storage-side links, respectively.

7. A storage network as defined in claim 1 wherein:

the plurality of storage-side links include a plurality of first storage-
side links and a plurality of second storage-side links;

each of the first storage-side links corresponds to one of the second
5 storage-side links and to one of the storage devices;

each of the first storage-side links connects to the corresponding
storage device, and the corresponding second storage-side link also connects to
the corresponding storage device;

the switch matrix establishes the communication channels for

10 transferring the message packets between the host device and any of the storage devices through either the first or second storage-side links; and

the host device is operative to access the same stored data through the switched fabric through either the first or the second storage-side links to the storage devices.

8. A storage network as defined in claim 7 wherein:

each first storage-side link and the corresponding second storage-side link form redundant data transfer paths between the switched fabric and the corresponding storage device.

9. A storage network as defined in claim 1 wherein:

the host-side link transfers and receives data to and from the host device at a first data transfer rate;

the storage-side links transfer and receive data to and from the

5 storage devices at a second data transfer rate lesser than the first data transfer rate;

the first data transfer rate defines a host-side bandwidth for the host-side link; and

the second data transfer rate for all of the storage-side links

10 combined defines a combined bandwidth for the storage-side links comparable to the host-side bandwidth.

10. A storage network as defined in claim 9 wherein:

the host-side and storage-side interfaces each include a serializer/deserializer;

each serializer/deserializer serializes parallel data into serial data

5 transferred from the switch matrix through the respective link to the respective host device or storage device;

each serializer/deserializer deserializes serial data into parallel data transferred from the respective host device or storage device through the respective link to the switch matrix; and

each serializer/deserializer operates at the data transfer rate for its

link.

11. A storage network as defined in claim 1 wherein the switched matrix comprises an edge switch.

12. A storage network as defined in claim 1 wherein a combination of the host device, the storage devices and the switched fabric comprises a data processing unit.

13. A storage network as defined in claim 12 wherein the data processing unit comprises a storage server.

14. A storage network as defined in claim 12 wherein the data processing unit comprises a personal computer.

15. A method of communicating data between a host device and a plurality of storage devices through a switched fabric comprising the steps of:

5 sending a data access request from the host device to the switched fabric;

directing the data access request to a selected one of the plurality of storage devices connected to the switched fabric;

establishing data transfer paths through the switched fabric from the host device to any of the storage devices and not between the storage devices;

10 establishing one of the data transfer paths between the host device and the selected storage device through the switched fabric;

sending the data access request from the switched fabric to the selected storage device; and

transferring data between the host device and the selected storage device in response to the data access request through the established data

15 transfer path in the switched fabric between the host device and the selected storage device.

16. A method as defined in claim 15 further comprising the steps of:

sending a second data access request, in addition to the data access request first aforesaid, from the host device to the switched fabric;

002220 - 002220

directing the second data access request to a second selected one of

- ## 5 the plurality of storage devices;

establishing a second one of the data transfer paths between the host device and the second selected storage device through the switched fabric;

the second selected storage device;

- 10

transferring second data between the host device and the second

selected storage device in response to the second data access request through the second established data transfer path by transferring the second data between the switched fabric and the second selected storage device and transferring the second data between the switched fabric and the host device; and

- 15

transferring the data first aforesaid between the switched fabric and the first selected storage device at the same time as transferring the second data between the switched fabric and the second selected storage device.

17. A method as defined in claim 16 further comprising the steps of:

transferring the first and the second data between the switched fabric and the first and the second selected storage devices, respectively, at a storage-side transfer speed; and

- 5

transferring the first and second data between the switched fabric and the host device at a host-side transfer speed that is at least twice the storage-side transfer speed.

18. A method as defined in claim 16 further comprising the steps of:

sending the first data access request from the host device to a first switch, the first switch comprising a first portion of the switched fabric, each of the storage devices being connected to the first switch;

- 5

sending the second data access request from the host device to a second switch, the second switch comprising a second portion of the switched fabric, each of the storage devices also being connected to the second switch;

establishing the data transfer path first aforesaid between the host device and the first selected storage device through the first switch:

0000000000000000

- 10 establishing the second data transfer path between the host device and the second selected storage device through the second switch;
- sending the first data access request from the first switch to the first selected storage device;
- sending the second data access request from the second switch to the second selected storage device;
- transferring the first data between the host device and the first selected storage device in response to the first data access request through the first established data transfer path through the first switch; and
- transferring the second data between the host device and the second selected storage device in response to the second data access request through the second established data transfer path through the second switch at the same time as transferring the first data between the host device and the first selected storage device.
19. A method as defined in claim 15 further comprising the steps of:
- sending a second data access request, in addition to the data access request first aforesaid, from a second host device, in addition to the host device first aforesaid, to the switched fabric;
- 5 directing the second data access request to a second selected one of the plurality of storage devices, in addition to the selected storage device first aforesaid;
- establishing the data transfer paths through the switched fabric from either of the first and second host devices to any of the storage devices and not between the storage devices;
- 10 establishing a second one of the data transfer paths, in addition to the established data transfer path first aforesaid, between the second host device and the second selected storage device through the switched fabric;
- sending the second data access request from the switched fabric to the second selected storage device;
- 15 transferring second data between the second host device and the

- (b) (5) AIA
- second selected storage device in response to the second data access request through the second established data transfer path in the switched fabric; and transferring the data first aforesaid between the first host device and
- 20 the first selected storage device in response to the first data access request through the first established data transfer path in the switched fabric at the same time as transferring the second data between the second host device and the second selected storage device.
20. A method as defined in claim 19 further comprising the steps of:
- sending the first data access request from the first host device to a first one of at least two switches, the at least two switches comprising the switched fabric and being connected to each of the storage devices;
- 5 sending the second data access request from the second host device to a second one of the at least two switches;
- establishing the first data transfer path between the first host device and the first selected storage device through the first switch;
- establishing the second data transfer path between the second host
- 10 device and the second selected storage device through the second switch;
- sending the first data access request from the first switch to the first selected storage device;
- sending the second data access request from the second switch to the second selected storage device;
- 15 transferring the first data between the first host device and the first selected storage device in response to the first data access request through the first established data transfer path through the first switch; and
- transferring the second data between the second host device and the second selected storage device in response to the second data access request
- 20 through the second established data transfer path through the second switch at the same time as transferring the first data between the first host device and the first selected storage device.

21. A method as defined in claim 15 in combination with managing a storage network, the storage network defined by the host device, the switched fabric and the storage devices, further comprising the steps of:

- 5 monitoring the host device, the switched fabric and the storage devices to detect for a capacity saturation condition;
- modifying the host device upon detecting a host device saturation condition;
- modifying the switched fabric upon detecting a switched fabric saturation condition; and
- 10 modifying the storage devices upon detecting a storage device saturation condition.

22. A storage network having a host device operative to access stored data, a plurality of storage devices operative to store the stored data and a switched fabric connecting the host device and the plurality of storage devices to communicate data access requests and transfer data between the host device and

- 5 the storage devices, the switched fabric comprising:
- a switch connected to the host device and the storage devices and comprising a single integrated circuit;
- a host-side link integrated in the switch and connected to the host device and including a host-side interface between the switch and the host device,
- 10 the host-side interface sending and receiving data to and from the host device;
- a plurality of storage-side links integrated in the switch and connected to the plurality of storage devices and each including a storage-side interface between the switch and a corresponding one of the storage devices, the storage-side interface sending and receiving data to and from the corresponding storage device; and
- 15 a switch matrix integrated in the switch and connected to the host-side link and the storage-side links and operative to establish communication channels between the host-side link and any of the storage-side links for

20 transferring message packets including the data between the host device and any
of the storage devices.

01643240-032200